

STATEMENT OF WORK
RWA # (USGS # MP-15-12)

Uninterruptible Power Supply (UPS) Backup Power for Server Room

1. INTRODUCTION:

The current Uninterruptible Power Supply (UPS) scheme for Astrogeology is no longer appropriate for our data center. There are safety issues with regards to the number of individual UPS units, disproportionate wall outlet availability, and in some situations – excessive current draw resulting in tripped circuit breakers, and thus server downtime. Significant short term growth in Astrogeology's storage capacity and computing power are necessitating a migration to a more robust UPS solution in the immediate future. A unit specifically designed for this type of situation will eliminate multiple points of failure of individual power supplies, address current safety issues, and supply much higher quality ("cleaner") power than the current power supplies. A single UPS will significantly reduce the clutter of wiring that currently exists. This will provide a backup power solution suitable for a data center of this scale. In addition, this is the first step in allowing us to migrate toward having a backup generator in the future, which will allow us to run server room air conditioning units under a power outage condition. All UPS design and selection decisions will accommodate a generator option for the future.

2. WORK REQUIREMENTS:

- A. Prior to work beginning or equipment being ordered, the winning bidder shall make an onsite visit to assess the conditions present.
- B. Based on item A above, vendor shall supply engineering drawings/electrical schematics and material list detailing all pertinent information for all electrical work outside of the proposed UPS unit. These must be approved by the USGS project manager and/or the City of Flagstaff prior to work commencing.
- C. Any USGS service disruption requires at least at least (5) five working days notice in advance. Include all costs associated with maintaining server room power and server room air conditioning units from a properly sized generator.
- D. Outages will only be approved on weekends; therefore contractor must plan for weekend work in their bid.
- E. No additional funds will be approved for failure to properly understand or plan for the existing conditions.
- F. All materials, including wiring and conduit, will be new and of the highest quality.
- G. An emergency power off switch will be provided in the server room as part of the scope of work.
- H. All work completed and system fully operational with 12 weeks of award of contract, to include engineering drawings as well as lead time in receiving UPS unit from

manufacturer. This includes all wiring to the server room panel, and all raceways and receptacles above servers.

- I. This will be a firm fixed price contract for a turn-key UPS solution, to include rewiring from the existing panel in the server room to the new raceway described in the technical portion of this document.
- J. All equipment will be provided, sized, and designed for integration to future generator installation.
- K. Factory start-up shall be provided on a 8hour/5day basis (24/7 optional). Start-up service shall include but will not be limited to the following visits - pre-energize visit to inspect installation and provide guidance to installers as required, start-up visit to perform all procedures and tests specified within UPS Installation and Operation manual, post-start-up visit for alarm notification configuration, operator training, generator testing, etc. All installation to be in accordance with manufacturer's instructions.
- L. The following procedures and tests shall be performed by Field Service personnel during the UPS startup:
 - 1) Observe the type of ventilation, the cleanliness of the room, the use of proper signs, and any other safety related factors.
 - 2) Check all the power connections for tightness.
 - 3) Check all the control wiring terminations and plugs for tightness or proper seating.
 - 4) Check the DC bus for a possible short circuit.
 - 5) Check input and Bypass power for proper voltages and phase rotation.
 - 6) Energize the UPS module and verify the proper DC, walkup, and AC phase on.
 - 7) Check the DC link holding voltage, AC output voltages, and output waveforms.
 - 8) Check the final DC link voltage and Inverter AC output. Adjust if required.
 - 9) Check for the voltage difference between the Inverter output and the Bypass source.
 - 10) Perform full-load, step-load, and battery discharge tests using supplier furnished load bank.
 - 11) Before leaving the site, the field service engineer shall familiarize responsible personnel with the operation of the UPS. The UPS equipment shall be available for demonstration of the modes of operation.
- M. All components of the UPS system (UPS module, batteries, and bypass/distribution cabinet) shall be covered by a standard two-year limited factory warranty and service protection package. Two-year limited factory warranty shall include 8/5 on-site repair/replacement coverage for the UPS (parts and labor). Two-year service protection package shall include 5x8 on-site repair/replacement for batteries; one (1) on-site UPS performance check/preventive maintenance visit, 24/7 technical support coverage, and 24/7 remote monitoring service (with monthly reports for UPS and battery performance). Vendor/manufacturer shall also offer, as an option, 24/7 on-site service support with guaranteed response times of 8, 4, or 2 hours. Additional preventive maintenance visits shall be available as an option for both UPS and battery components. Manufacturer shall also include Start-up services consisting of: 8/5 Start-up service of UPS and batteries, On-site user training, site audit, installation and commissioning of monitoring service, and validation of two-year limited factory warranty. Vendor/manufacturer shall also

offer an optional service plan to provide 24/7 on-site coverage (preventive and corrective) for UPS and batteries, guaranteed response time, remote monitoring, Web access to service site history, annual Site Audit, UPS and battery preventive maintenance visit, and discounts on upgrade and modification kits. Vendor shall also provide an optional battery service plan to provide parts-and-labor coverage for partial and full battery strings, either with preventive maintenance or replacement coverage.

3. TECHNICAL SPECIFICATIONS:

- A. **SNMP Network Adapter and UPS Power Monitoring Software:** SNMP adapters shall provide a communications interface between the UPS module and SNMP-compatible network management systems. This capability shall allow the unit to be monitored remotely over an Ethernet network using a standard web browser. UPS Power Monitoring Software shall continuously monitor critical power elements associated with the UPS, using the communications port on each module and a customer furnished PC. The system shall automatically alarm if any problems arise and notify local or remote personnel of the alarm condition via email, page, or text message.
- B. The battery cabinet shall feature valve regulated, high-rate discharge, lead-acid batteries which provide energy to the support the critical load during a momentary loss of input power to the rectifier. The batteries shall be flame retardant in accordance with UL 94V2 requirements.
- C. **Rectifier/charger input:**
 - 1) Nominal three phase input voltage: 208 (or 480) VAC 3-wire plus ground for 3-wire plus ground output configuration, 4-wire plus ground for 4-wire plus ground output configuration.
 - 2) Operating input voltage range: + 10%, - 15% of average nominal input voltage without battery discharge.
 - 3) Operating input frequency range shall be 55 to 65Hz.
 - 4) Input power factor 0.99 lagging.
 - 5) For nominal input, rectifier/charger input current limit shall be adjustable from 100 to 125% of full-load input current. Battery input current limit shall be adjustable from 10% to 15% of the UPS full load input current regardless of the actual load on the UPS.
 - 6) For generator input current limit, the rectifier/charger input current limit shall be adjustable from 50% to 125% of full-load input current. Battery recharge input current limit shall be adjustable from 10% to 25% of the UPS full load input current regardless of the actual load on the UPS.
 - 7) Input current total harmonic distortion (THD) shall be less than 5%.
 - 8) Power walk-in: Ramp-up to full utility load adjustable from 3 seconds to 60 seconds.

D. Rectifier/charger output:

- 1) Nominal DC voltage shall be variable between 384VDC to 480VDC for 208V input, and between 432VDC to 480VDC for 480V input.
- 2) Steady state voltage regulation shall be +/- 0.5%.
- 3) Voltage ripple shall be less than 0.5% (peak-to-peak).
- 4) Capacity: The rectifier/charger shall support a fully loaded inverter and recharge the battery to 95% of its full capacity within 10 times the discharge when input current limit is set at maximum.
- 5) Low line operation: The rectifier/charger shall be capable of sharing the DC load with the battery when the input voltage falls below the specified operation input voltage range, the on-battery indicator shall display operation in this mode.
- 6) Automatic and manual means must be provided for battery equalization.
- 7) Redundant DC voltage sensing methods shall be incorporated for providing battery over-voltage protection.

E. UPS output in normal mode

- 1) Nominal output voltage 208 VAC, 3-phase, 3 wire or 4-wire (or 480V, 3-phase, 3-wire or 4 wire) plus ground at the output of the Integrated Distribution and Bypass cabinet. Output wiring configuration is based upon input wiring configuration for systems without internal transformers.
- 2) Steady-state voltage regulation (in inverter) shall be within +/- 1% average from nominal output voltage.
- 3) Transient voltage response shall be < +/- 5% from nominal voltage for 100% load step, full load re-transfers and full load drop on battery.
- 4) Transient voltage recovery shall be 25ms to within +/- 1% of steady state.
- 5) Linear load harmonic distortion capability - Output voltage THD of less than 2% for 100% linear load.
- 6) Non-linear load harmonic distortion capability - Output voltage THD of less than 5% for 100% non-linear load when tested using the non-linear load described in IEC 62040-3 connected line to neutral.
- 7) Manual output voltage adjustment shall be minimum +/- 3% from nominal.
- 8) Line synchronization range shall be +/- 3Hz, adjustable to +/- 5Hz.
- 9) Frequency regulation shall be +/- 0.01Hz free running.
- 10) Frequency slew rate shall be 1 Hz/second maximum (adjustable).
- 11) Phase angle control - Balanced linear load shall be +/- 1 degree from nominal 120 degrees and 1 degree from nominal 120 degrees. Unbalanced linear loads shall be better than +/- 5degrees from average phase voltage for 100% load unbalance and better than +/- 5degrees from average phase voltage for 100% load unbalance.

- 12) Phase voltage control balanced linear loads shall be $\pm 1\%$ from average phase voltage. Unbalanced linear loads shall be better than $\pm 5\%$ for 100% load unbalanced.
- 13) Overload current capability (with nominal line and fully charged battery) – Unit must maintain voltage regulation for up to 110% of resistive/inductive load for 10 minutes, up to 125% for 30 seconds, and up to 150% for 10 seconds.
- 14) Fault clearing current capability: 150% phase-to-phase for 10 cycles; 300% phase-to-neutral for up to 10 cycles.
- 15) Static transfer time - No break, completed in less than 4ms.
- 16) Common mode noise attenuation minimum parameter shall be -60dB up to 20kHz, -40db up to 100kHz, > 100dB with isolation transformer.

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- 2) Steady-state voltage regulation (in inverter) shall be within $\pm 1\%$ average from nominal output voltage.
- 3) Transient voltage response shall be $< \pm 5\%$ from nominal voltage for 100% load step, full load re-transfers and full load drop on battery.
- 4) Transient voltage recovery shall be 25ms to within $\pm 1\%$ of steady state.
- 5) Linear load harmonic distortion capability - Output voltage THD of less than 2% for 100% linear load.
- 6) Non-linear load harmonic distortion capability - Output voltage THD of less than 5% for 100% non-linear load when tested using the non-linear load described in IEC 62040-3 connected line to neutral.
- 7) Manual output voltage adjustment shall be minimum $\pm 3\%$ from nominal.
- 8) Line synchronization range shall be $\pm 3\text{Hz}$, adjustable to $\pm 5\text{Hz}$.
- 9) Frequency regulation shall be $\pm 0.01\text{Hz}$ free running.
- 10) Frequency slew rate shall be 1 Hz/second maximum (adjustable).
- 11) Phase angle control - Balanced linear load shall be ± 1 degree from nominal 120 degrees. Unbalanced linear loads shall be better than ± 5 degrees from average phase voltage for 100% load unbalance.
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 - 14) Fault clearing current capability: 150% phase-to-phase for 10 cycles; 300% phase-to-neutral for up to 10 cycles.
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- G. Noise generated by the UPS under normal operation shall not exceed 70dbA at one meter from any operator surface, measured at 25 degrees C (77 degrees F) and full load.
 - H. EMI Suppression shall meet FCC rules and regulation 47, part 15, for Class A devices.
 - I. UPS input to output efficiency shall be 92-94% at full load, unity power factor (1.0) and nominal input voltage excluding any distribution or bypass voltage matching or isolation transformers.
 - J. The UPS shall meet IEC 801-2 specifications for Electrostatic discharge (ESD). The UPS shall withstand a 2.5 kV pulse without damage and with no disturbance or adverse effect to the critical load.
 - K. The UPS shall be housed in free-standing double front enclosures (safety shields behind doors) equipped with casters and leveling feet. The enclosures shall be designed for computer room applications.
 - L. The UPS shall be designed for forced-air cooling. Air inlets shall be on the front of the unit. Air outlets shall be on the top. No back or side clearance or access shall be required for the system.
 - M. Standard cable entry for the UPS cabinet shall be through either the enclosure bottom or top. A dedicated wire way shall be provided within the UPS cabinet for routing user input and output wiring.
 - N. A dry contact for annunciating a summary alarm shall be provided for customer use. This contact shall be capable of supplying N/O or N/C states and shall be rated for operation at a minimum of 10 Amps at 240VAC or 14VDC.
 - O. RS232 (EIA / TIA-232) communications interface: Circuitry shall be provided for one RS232 (EIA / TIA-232) communication port for connection to automated service department diagnostic tools. This port may be used with simple ("dumb") terminals to gain remote access to all unit operation information.
 - P. Two inputs shall be provided for monitoring the status of external dry contacts. Building alarms shall be set up through the UPS configuration mode function on the RS232 (EIA / TIA-232) port.
 - Q. External EPO contacts shall be provided to connect an external remote emergency power off switch to shutdown the UPS and de-energize the critical load.
 - R. A connection point shall be provided to acknowledge that an external maintenance bypass has been closed around the UPS, placing the critical load on utility power.
 - S. The UPS shall be equipped with field configurable communications bays that will accommodate two (2) communication devices. A communication bay upgrade shall be available to increase the quantity of communication devices up to four (4). The UPS shall include WEB/SNMP communication support as standard.

- T. The UPS shall be able to be monitored locally or across a network. Monitoring of UPS status may also be performed through isolated dry contact Form C relays. Communication via modem for monitoring shall also be possible. The UPS should be able to integrate into any industry standard Building Management System (BMS) and/or Network Management System (NMS). The UPS must also be able to be monitored and managed via any standard internet browser (i.e. Internet Explorer and Netscape), PDA or cell phone.
- U. There shall be a mechanism that provides graceful, orderly, unattended, sequential shutdown of one or multiple computers powered by one UPS. This shutdown shall be performed via in-network or out-of-network means. The order of shutdown shall be user-defined, allowing the maximization of runtime on battery for more critical systems. The UPS shall also be capable of interfacing with an operating system's built-in shutdown routine, e.g. Windows NT. This shall be done through a cable connection to the optional serial port on the UPS.
- V. To comply with agency safety requirements, the UPS module shall not rely upon any disconnect devices outside of the UPS module to isolate the battery cabinet from the UPS module.
- W. UPS Module shall operate as an on-line, fully automatic system in the following modes:
 - 1) Normal: Utilizing commercial AC power, the critical load shall be continuously supplied by the Inverter. The Inverter shall power the load while regulating both voltage and frequency. The Rectifier shall derive power from the commercial AC source and shall supply DC power to the Inverter. Simultaneously, the Battery Charger shall charge the battery.
 - 2) Bypass: If the UPS module must be taken out of the Normal mode for overload, load fault, or internal failures, the static bypass switch shall automatically transfer the critical load to the commercial AC power. Return from Bypass mode to Normal mode of operation shall be automatic. No-break transfer to and from Bypass mode shall be capable of being initiated manually from the front panel.
 - 3) Battery: Upon failure of the commercial AC power, the critical load shall continue to be supplied by the Inverter, which shall obtain power from the batteries without any operator intervention. There shall be no interruption to the critical load upon failure or restoration of the commercial AC source.
 - 4) Recharge: Upon restoration of the AC source, the Charger shall recharge the batteries and simultaneously the Rectifier shall provide power to the Inverter. This shall be an automatic function and shall cause no interruption to the critical load.

X. The UPS module shall consist of the following standard components:

- 1) The rectifier/charger shall convert incoming AC power to regulated DC output for supplying the inverter and for charging the battery. The modular design of the UPS shall permit safe and fast removal and replacement of the rectifier/charger module. Mean time to repair (MTTR) for the module shall be no more than 30 minutes in order to return UPS to normal mode. The rectifier/charger must also be capable of drawing power from the utility with a power factor of 0.99 under nominal conditions.

- 2) The inverter shall feature an IGBT pulse-width-modulation (PWM) design with high speed switching. The inverter shall be capable of providing the specified quality output power while operating from any DC source voltage (rectifier or battery) within the specified DC operating range. The modular design of the UPS shall permit safe and fast removal and replacement of the inverter module. Mean time to repair (MTTR) for the module shall be no more than 30 minutes in order to return UPS to normal mode. The inverter shall feature protection circuitry that prevents the IGBTs from sourcing current in excess of their published ratings.
 - 3) The static bypass shall serve as an alternative source of power for the critical load when performing maintenance on the UPS, or when a failure prevents operation in normal mode. The bypass shall consist of a fully rated, naturally-commutated static switch for high-speed transfers. Transfers to bypass shall be automatically initiated for output overload period expired, critical bus voltage out of limits, over temperature period expired, total battery discharge, or UPS failure. Uninterrupted automatic re-transfer shall take place whenever the inverter is capable of assuming the critical load. Uninterrupted automatic re-transfers shall be inhibited when transfer to bypass is activated manually or remotely. In the event of multiple transfers/re-transfer operations the control circuitry shall limit "cycling" to three (3) operations in any ten minute period. The fourth transfer shall lock the critical load on the bypass source or UPS failure. Uninterrupted manual transfers shall be initiated from the control panel. Uninterrupted manual transfers to bypass and from bypass shall be possible with the inverter logic. During manual transferring the critical load to the bypass. All transfers to bypass shall be inhibited for Bypass voltage out of limits (+/- 10% of nominal), Bypass frequency out of limits (+/- 3 Hz, adjustable, factory set), bypass out of synchronization, Bypass phase rotation / installation error.
 - 4) Upon restoration of the AC source, the charger shall recharge the batteries and simultaneously the rectifier shall provide power to the inverter. This shall be an automatic function and shall cause no interruption to the critical load.
- Y. An integrated maintenance bypass and output distribution cabinet shall be provided that includes All hardware and interconnecting cable for connection to UPS module and Rotary maintenance bypass switch to isolate UPS module from commercial AC input and critical load. Switch shall provide complete isolation of UPS for servicing and, if necessary, complete removal and replacement of UPS while still providing bypass power to critical load. Switch shall be 2-position, make-before-break, interlocked between UPS and bypass to prohibit improper operation.
- Z. UPS has an audible alarm to alert personnel at least 5 minutes (this time should be user programmable) before UPS shutdown due to low batteries.
- AA. UPS has a minimum battery life of 4 years with replacements available.
- BB. All hardware, software, cabling and are included.
- CC. The UPS shall be supplied with sufficient documentation, including theory of operation, operating procedures, system events, maintenance, performance and technical specifications, physical features and dimensions, and optional accessory options and operation.

- DD. The UPS shall withstand any combination of the following external environmental conditions without operational degradation- Operating Temperature: 0 degrees C to + 40 degrees C (32 degrees F to 104 degrees F) without de-rating (excluding batteries), storage Temperature: - 25 degrees C to + 60 degrees C (-13 degrees F to 140 degrees F), prolonged storage above + 40 degrees C (104 degrees F) will cause rapid battery self-discharge, Relative humidity for operation and storage 95% maximum non-condensing, operational to 7600 ft elevation without de-rating.
- EE. The battery management system shall provide battery time remaining while operating in normal mode and battery mode. Battery time available information shall be displayed real-time, even under changing load conditions. Upon commissioning, battery runtime information shall be available. Upon detection of the battery string(s) not capable of providing 80%, the UPS system will alarm that the battery needs attention/replacement.
- FF. An optional temperature sensor shall be available to monitor the ambient temperature internal to the battery cabinet. If the ambient temperature increases, the UPS system charger shall automatically reduce the charging voltage to a level recommended by the battery manufacturer. If the ambient temperature is decreased the UPS shall automatically increase the battery charge voltage to that recommended by the battery manufacturer. Battery life, capacity, and failure information shall be part of the UPS remote monitoring information.
- GG. **UPS has a minimum load capacity 80KVA.**
- HH. **UPS has a run time of at least 30 minutes under 30KW load.**
- II. **Transfer switch for a future generator to be installed and rated at 600amps.**
- JJ. **Install raceways above servers providing (48) 20 amp circuits with NEMA L5-30P type connections to accommodate 4 circuits for each of the 12 server racks. These connectors may be located on the walls, or above the racks in the raceways, as determined during the engineering phase. The raceways must be large enough to accommodate both power and data cables, and must have dividers to keep the two separated. Maintain (4) 20 amp circuits on each wall where they currently exist. In addition, engineering and installation accommodations must be made for the 2 current 240v "temporary" circuits in the server room.**
- KK. UPS to be anchored to the floor per manufacturers recommendations.
- LL. All grounding and bonding of the UPS will be in accordance with manufacturer's recommendations.
- MM. If a brownout occurs, the UPS will boost the voltage to within normal limits before it reaches the computer; UPS will run the computer under these conditions without draining its batteries.
- NN. The UPS manufacturer shall maintain a staffed 24/7/365 call center for technical and emergency support.
- OO. **Field Engineering Support: The UPS manufacturer shall directly employ a nationwide field service department staffed by factory-trained field service engineers dedicated to startup, maintenance, and repair of UPS equipment. The organization shall consist of local offices managed from a central location. Field engineers shall be deployed in key population areas to provide on-site emergency response within 24 hours. A map of the United States showing the location of all field service offices must be submitted with the proposal. Third-party maintenance will not be accepted.**

PP. Spare Parts Support: Parts supplies shall be located in the field to provide 80% of all emergency needs. The factory shall serve as the central stocking facility where a dedicated supply of all parts shall be available within 24 hours.

QQ. Maintenance Contracts: A complete range of preventative and corrective maintenance contracts shall be provided and offered with the proposal. Under these contracts, the manufacturer shall maintain the user's equipment to the latest factory revisions.